Nigerian J. Anim. Sci. 2018, 20 (4): 567-575

Grazing capacity comparison of *Andropogon gayanus and Panicum maximum sward* established by Seed and Transplant *propagules*

Nweze B.O.

Department of Animal Science, Ebonyi State University, Abakaliki, Ebonyi State

Corresponding Author: obasinweze@gmail.com. ***Phone No.*:** +2348037466742

Target Audience: Pasture Agronomist, Animal Scientist, Ranch Managers and Researchers

Abstract

The capacity to withstand grazing by Muturu cattle on two pasture sward established by seed and transplant propagules under humid tropical environment of South-Eastern Nigeria was conducted by determining the forage dry matter (Dm) yield of the two pasture propagules in four seasons. The grazing defoliation, the relative growth rate and the stocking rates of the forages were calculated. The results show that the Dm yield, from A.gayanus seed propagule harvested on the month of June-August was the highest, while the least Dm yield was recorded from gayanus transplant propagules on the month of December-February. The grazing defoliation occurred more with P. maximum than A.gayanus, while the seed propagules had less defoliation than transplant propagules. The highest defoliation occurred from the month of December to February which is the dry season period while the least occurred from the month of June to August, which is the peak rainfall period. The relative growth rate varied significantly ($P < 0.05$) among forage propagules and between the seasons. The grazing efficiency and grazing capacity differs significantly ($P < 0.05$) among the propagules. Muturu cattle had the best weight gain per hectare on A. gayanus seed propagule from the month of March to May. The maximum stocking rate was recorded with A. gayanus seed propagule from the month of June to August, while the minimum stocking rate was recorded with A. gayanus transplant propagule from December to February.

***Keyword**:* Grazing capacity, forage sward, seeds, transplant *propagules*.

Description of Problem

The capacity of pasture species to withstand grazing either as sward or forage rangeland depends on the characteristics of such pasture species. The attribute of grazing capacity is of great concern to pastoralist because it is associated to forage persistency and grazing tolerance, which is considered as the relevant factors required for pasture establishment and sustenance. The availability of forage species during field grazing is a key factor toward satisfying the nutritional need of ruminants especially under the present unpredictable grazing environment caused by the effect of global climate change. Climate change affects both quantity and quality of tropical forages in any grazing territory (1). The nature of grazing territory which is a function of many ecological factors such as soil micro-environment, plant species, topography and weather condition affect the overall productivity of ruminant animals (2).

Grazing capacity defines the grazing territory within the tropical environment in term of Carrying Capacity or Tropical Livestock unit (3). Forage attribute like grazing capacity can be influenced by both the social interaction among the herd mates of ruminant animals and their grazing environment. This is because within the grazing environment, there are variations among the herd mates in term of age, sex and physiological state of animals; forage species, spatial distribution, composition, density, surface sward height of plant species and weather condition that make up the grazing territory (4). The nature of grazing environment determines the ability of forage species to generate biomass. The quantity of forage biomass in a grazing territory determines the carrying capacity. Grazing environment changes because of the effect of climate, grazing system inter and intra-species competition of plant within its ecological zone (5). Reports have shown that the factors named above contribute much to the relative abundance of tropical forage species within the grazing environment. It has been observed that plant-animal interactions and soil micro-environment within eco-climatic condition affect grazing activities in any grazing territory (6). This is because good pasture provides for high forage density and high nutrients, which might reduces grazing travel distance and increases effective grazing time of ruminants. Less grazing travel distance or high grazing time is an indication of grazing efficiency (7). One of the ways to determine a successful grazing activity is by calculating the grazing efficiency of the forage. It is important to determine forage consumed by ruminant animals at a time without exposing the soil for erosion or cause damage on grazing territory. This is why a study like this is important. Grazing efficiency is a function of available pasture and the number of grazing animals as well as the forage grazing capacity (8).

Grazing capacity can be measured through stocking rate, which has been defined by various models including livestock performance model and maximum gain per unit area model (8). The maximum gain per unit area stipulates the live weight gain of farm animal per unit hectare. The maximum gain occurs at slop where live weight gain per unit grazing area is zero (8). Grazing capacity is crucial in comparing pasture species performance during establishment as sward or during pasture maintenance on rangeland. The rate of forage defoliation is determined by ruminant grazing capacity as well as the livestock productivity. There are variations on grazing capacities of forage species within any grazing territory. Such variation can be determined and used as tools by pasture agronomist during establishment or maintenance of pasture.

A. gayanus and *P. maximum* are two common tropical forage species for pasture establishment and the study of their attributes is crucial for the determination of their ease of establishment and sustainability for pasture production.

Materials and Methods

The study was conducted at Paddock Development Unit of Department of Animal Science, Ebonyi State University, Abakiliki Southeast Nigeria. The location is characterized with dysteric leptosol soil (9) with pseudo-bimodal rainfall (10). *Andropogon gayanus* and *Panicum maximum* seeds and transplant *propagules*, which were used for the trials were planted within four periods of rainfall; namely early rain (March to May), mid rain (June to August), late rain (September to November) and dry season (December to February).

A completely randomized block design (CRBD) was used for the experiment. Each trial constituted a pasture species planted on two blocks. A block contains either a seed or a transplant. There were two plots in each block with eight sub plots and pathways. Each sub plot comprises four replicates of 0.5ha which were used for *A. gayanus* and *P. maximum* seed and transplant *propagules*. The sward was allowed for one year proper establishment before cutting took place. A metre square was randomly selected from each sample sub-plot and cut to determine the dry matter yield at the second year. This occurred at every two week interval. The samples of each trial were cut, weighed and oven dried and reweighed for the Dm analysis.

Muturu Cattle were grazed on the sward the following year after the cutting. Five animals were grazed on each replicate per period. Grazing occurred daily, in the morning (9.00-11.00 a.m.) and evening (3.30 – 5.30 p.m.).Stocking rate and grazing defoliation were determined by calculation using the individual animal performance model (8).

Y=a-bx, where Y = the average daily weight gain, x = grazing area, a = constant and b = the stocking rate. Also the relative growth rate of the forages was determined every four weeks after grazing by calculating relative standing crop or relative forage biomass (8,) . The data were analysed using Least Square Mean Analysis to compare the mean (11).

Results and Discussion

The result of dry matter yield is shown in Table I. There were significant differences ($P < 0.05$) in the forage dry matter yield. Mid rain (June-August) had the highest yield in all the treatments. This could be due to the availability of rain that increased the soil moisture. Soil moisture, warmth and aeration are the condition that promotes germination; increase root formation, high tiller production as well as the shoot growth and vegetation of grass species (12, 13, 14). This condition, which is required for high biomass production is available during the mid-rainfall period.

The low dry matter yield from the transplant *propagules* during the dry season is understandable because of the low plant density emanating from dehydration and wilting of propagules during the process of propagation. Under low soil moisture and high temperature condition, there could be poor pasture establishment due to harsh soil micro-environment (15, 16) *A. gayanus* is among the grass species that can lose moisture easily during transplanting and die because of dehydration (17). However this is not the case with *A. gayanus and P. maximum* seed *propagules* with dry matter yield from high germination and survival rate, which resulted to increase plant density, vegetation and plenty biomass. It has been reported that forage biomass determines bite mass and grazing time of cattle (18, 19). Cattle graze more where forage density is high and this allows rapid forage intake (20). Animals fill their mouth sufficiently with leafy vegetation, which reduces bite number and allows short grazing time (21).

Table 2 shows the grazing defoliation and relative growth of the in which there were significant differences ($P < 0.05$) among the *propagules* and between the two seasons. Grazing defoliation occurred most in dry season, with a corresponding lowest relative growth rate during the period. The reason could be due to lose of forage biomass from the effect of harsh weather condition that caused death and reduction of plant growth during dry season. Also, trampling of forages by field grazing animals is more evident during dry period as a result of the to and fro movement in search of forage to satisfy their energy and other nutritional need (18). There are several factors that could lead to rapid defoliation during dry season such as intense grazing or over grazing, drought and soil erosion (19). The intensity of grazing is determined by the nature grass species such as canopy height, density, and spatial arrangement of plant (19). Tall and dense sward might offer higher intake based on the fact that canopy facilitates large bite, which may increase the rate of defoliation. Also, low-density forages increase the movement of grazing animals, which might subsequently increase trampling effect. Moreover, dungs from ruminant animals could generate heat that increase soil temperature, a condition that might result to defoliation (20). The mid rainfall period provided the maximum soil moisture condition particularly with *A. gayanus seed propagules* for the best relative growth period. It appears that the seed *propagule* had less defoliation during this period because of high biomass and hence offered better grazing environment than transplant *propagule.*

The grazing efficiency and grazing capacity is shown in t*able 3. A. gayanus* seed *propagules* had the best result probably due to high survival rate and development. Grazing efficiency is high probably due to the fact that the grass *propagule* had the biomass that facilitated the increase in carrying capacity. It has been reported that carrying capacity of a pasture species is positively correlated with the density and the topography of pasture area (21, 22). Reports have shown that sward containing one species of forage usually possess characteristics that offers greater bite and penetration into canopy, thus greater grazing efficiency (23, 24). Increase in forage utilization could occur in high forage density environment because there is reduction in grazing travel distance with the corresponding increment in grazing time (24, 25). Movement of ruminant animals on a high plant density environment reduces as a result of increase in grazing time (8). The movement also affects plants loses due to trampling because the affected plant could be easily regenerated during rainy season.

Figure 1 shows the stocking rate of Muturu cattle in which *A. gayanus seed propagules* was the best in the mid-rain period also indicated that P. maximum seed propagules also had high result during the period. The high abundance of forage within seed *propagules* in mid rain gave rise to result obtained from the stocking rate. Stocking rate is dependants on available plant biomass and the number of ruminant animals on a grazing territory (8). Under tropical climate condition, the method of propagation as well as the season is a factor to be considered as revealed the propagules.

Table 4 and table 5 show weight gain and stocking rate of Muturu cattle under field grazing respectively. The weight gain per hectare differed significantly ($P < 0.05$) among forage *propagules*, probably due to quantity and quality of forages available at the plots within each season. Report has shown that within the early rain period the forage are more succulent with higher nutrients than any other season (27). As the grasses grow older, they become lignified and their nutrients become unavailable in body of animal for productivity use (5). The highest stocking rate found on *A. gayanus* pasture *propagules* within mid rain fall period is an important factor in agronomic process of pasture production

Conclusion and Applications

1. It could be concluded from the result that propagation by seed during sward establishment could be better than vegetative means in both *A. gayanus* and *P. maximum.*
2. The grazing capacities of *A. gayanus and P maximum transplant propagules* are poor especially during dry season and that of rainy season could produce better result from both pasture species under non irrigation establishment.
3. Ranch managers could exploit the peculiar characteristics between *A. gayanus and P. maximum* in terms of high relative growth rate and low defoliation of seed *propagules* during pasture establishment.
4. The grazing capacity of the two forage transplant *propagules* is low in humid tropical soil of South East Nigeria especially during dry season; therefore

further studies could be required to determine other factors affecting the two forage *propagules*, and how to improve the propagation method of two grass species during pasture establishment.

Table 1: Dry matter yield of *A. gayanus* and *P. maximum* sward established by seed and transplant *propagules*

Duration	A_s(Kg)*	A_t(Kg)	P_s(Kg)	P_t(Kg)	**CV**
Early rain	4982.92^{c}	3326.70^{c}	4448.86^{c}	3391.19^{c}	277.23
Mid rain	7537.50^{a}	5082.51^{a}	5907.14^{a}	5098.12^{a}	691.95
Late rain	5746.59^{b}	3708.52^{b}	3978.86^{b}	3738.86^{b}	231.54
Dry season	4335.23^{d}	3037.50^{d}	3448.86^{d}	3213.06^{d}	198.72

$^{a,,b,c,d:}$ Means in the same column with different superscript are significantly different ($P < 0.05$).

***Key**
A_s = *Andropogon gayanus* seed *propagules*
A_t = *Andropogon gayanus* transplant *propagules*
P_s = *Panicum maximum* seed *propagules*
P_t = *Panicum maximum* transplant *propagules*
Early rain = March – May
Mid rain = June – August
Late rain = September – November
Dry season = December – February
CV: Coefficient of variation

Table 2: Least square mean for the grazing defoliation percentage (GDP) and relative growth rate (RG) of *A. gayanus* and *P. maximum* sward established by seed and transplant *propagules*

Variable	Overall LSM	No. of Plot	GDP (%)	RG (%)
	A. gayanus	16	62.82	10.07
Species	*P. maximum*	8	52.51^{b}	10.17
	Seed *propagules*	8	66.02^{a}	9.96
Propagules	Transplant *propagules*	8	54.49^{b}	10.53^{a}
	Dry	8	64.03^{a}	9.61^{b}
	Early			
	Mid rain			
	Late rain			
Seasons		8	68.42^{a}	5.27^{d}
		8	63.85^{a}	9.24^{b}
		8	45.92^{c}	10.54^{a}
		8	55.87^{b}	7.34^{c}

^{a,b,c,d,}Within variable means without common superscript differ significantly ($P < 0.05$).

***Key**
A_s = *Andropogon gayanus* seed *propagules*
A_t = *Andropogon gayanus* transplant *propagules*
P_s = *Panicum maximum* seed *propagules*
P_t = *Panicum maximum* transplant *propagules*
Early rain = March – May
Mid rain = June – August
Late rain = September – November
Dry season = December – February

Table 3: Grazing efficiency and grazing capacity of *A. gayanus* and *P. maximum* sward established by seed and transplant *propagules*

Parameters	A_s	A_t	Ps	P_t	CV
Grazing Efficiently (%)	41.20[a]	13.20[d]	28.40[b]	17.23[c]	5.32
Grazing Capacity (%)	11.75[a]	4.75[d]	8.25[b]	5.25[c]	0.89

[a,b,c,d,]Means in the same row with different superscript are significantly different (P < 0.05).

***Key**

A_s = *Andropogon gayanus* seed *propagules*
A_t = *Andropogon gayanus* transplant *propagules*
P_s = *Panicum maximum* seed *propagules*
P_t = *Panicum maximum* transplant *propagules*
Early rain = March – May
Mid rain = June – August
Late rain = September – November
Dry season = December – February

Table 4: Average weight gain per month per/ha of Muturu cattle on *A. gayanus* and *P. maximum* sward established by seed and transplant *propagules*

Duration	A_s (Kg)	A_t (Kg)	Ps (Kg)	P_t (Kg)	CV
Dry Season	0.41[d]	0.33[b]	0.41[c]	0.35[c]	0.07
Early Season	1.33[a]	0.50[a]	1.01[a]	0.61[a]	0.18
Mid Rain	0.83[b]	0.45[a]	0.51[b]	0.48[b]	0.05
Late Rain	0.75[c]	0.39[ab]	0.47[bc]	0.41[bc]	0.08

[abc]Means in the same column with different superscript are significantly different (P < 0.05).

***Key**

A_s = *Andropogon gayanus* seed *propagules*
A_t = *Andropogon gayanus* transplant *propagules*
P_s = *Panicum maximum* seed *propagules*
P_t = *Panicum maximum* transplant *propagules*
Early rain = March – May
Mid rain = June – August
Late rain = September – November
Dry season = December – February

Table 5: Stocking rate head/ha of Muturu cattle on *A. gayanus* and *P. maximum* sward established by seed and transplant *propagules*

Duration	A_s	A_t	Ps	P_t	CV
Dry Season	5	2	4	3	3
Early Season	10	5	8	7	4
Mid Rain	16	6	12	8	3
Late Rain	9	4	7	5	3

***Key**

A_s = *Andropogon gayanus* seed *propagules*
A_t = *Andropogon gayanus* transplant *propagules*
P_s = *Panicum maximum* seed *propagules*
P_t = *Panicum maximum* transplant *propagules*
Early rain = March – May
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Dry season = December – February

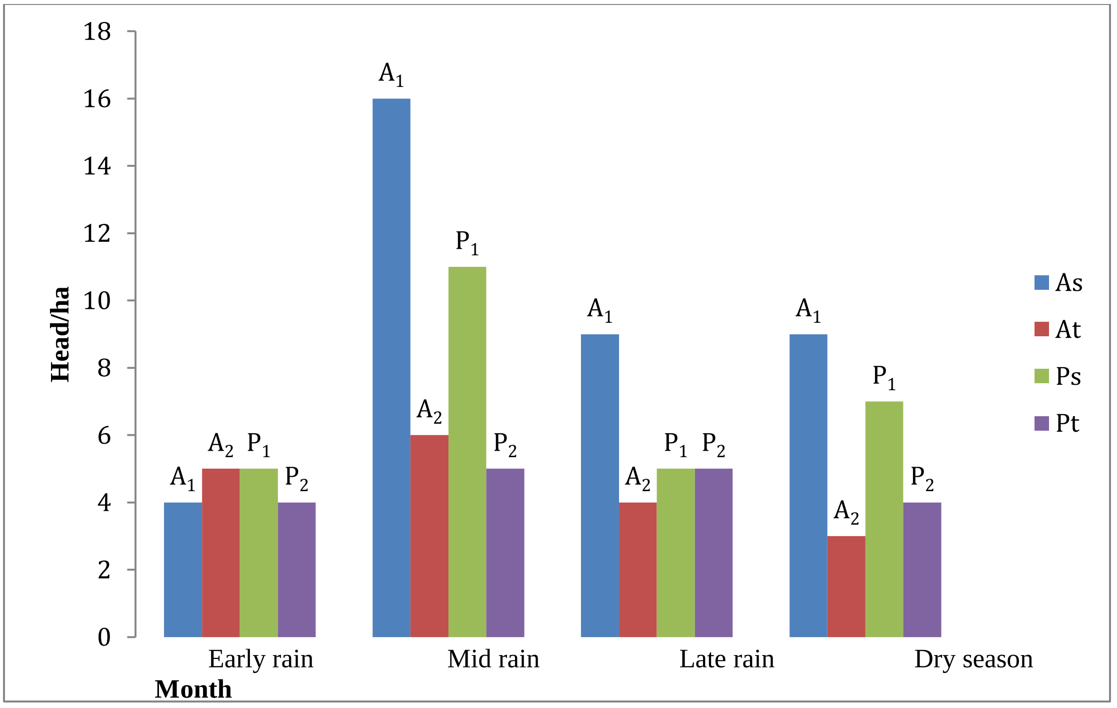

Figure 1: Stocking rate of Muturu Cattle on *Andropogon gayanus* and *Panicum. maximum* sward established by seed transplant *propagules*

A_1=A. gayanus seed propagules

A_2=A. gayanus transplant propagules

P_1=P. maximum seed propagues

P_2=P. maximum transplant propagules

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